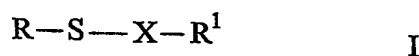


Claims

1. A method of forming a disulfide bond, the method comprising reacting an  
5 organic compound comprising at least one thiol group with a compound of formula I:



10 wherein:

X denotes SO<sub>2</sub> or Se;

R denotes an organic moiety; and

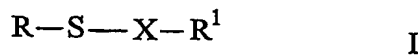
R<sup>1</sup> denotes an optionally substituted alkyl group, an optionally substituted  
phenyl group, an optionally substituted pyridyl group or an optionally substituted  
15 naphthyl group;

with the proviso that when X denotes SO<sub>2</sub> then R<sup>1</sup> does not denote optionally  
substituted alkyl.

2. A method according to claim 1, wherein the organic compound comprising  
20 at least one thiol group is an amino acid, a peptide or a protein.

3. A method of chemically modifying a protein, peptide or amino acid  
comprising at least one thiol group, the method comprising reacting said protein,  
peptide or amino acid with a compound of formula I:

25



wherein:

X denotes SO<sub>2</sub> or Se;

30 R denotes an organic moiety; and

R<sup>1</sup> denotes an optionally substituted alkyl group, an optionally substituted  
phenyl group, an optionally substituted pyridyl group or an optionally substituted  
naphthyl group;

with the proviso that when X denotes SO<sub>2</sub> then R<sup>1</sup> does not denote optionally substituted alkyl.

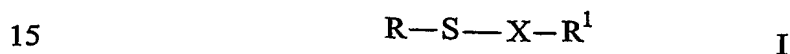
4. A method according to any one of claims 1 to 3, wherein R is a carbohydrate  
5 group.

5. A method according to any one of claims 1 to 4, wherein R<sup>1</sup> is phenyl.

6. A method according to any one of claims 1 to 5, wherein X is Se.  
10

7. A method according to any one of claims 1 to 5, wherein X is SO<sub>2</sub>.

8. A compound of formula I:



wherein:

X denotes SO<sub>2</sub> or Se;

R denotes a carbohydrate moiety; and

20 R<sup>1</sup> denotes an optionally substituted alkyl group, an optionally substituted phenyl group, optionally substituted pyridyl group or an optionally substituted naphthyl group;

with the proviso that when X denotes SO<sub>2</sub>, then R<sup>1</sup> does not denote optionally substituted alkyl.

25

9. A compound according to claim 8 wherein R<sup>1</sup> is phenyl.

10. A compound according to claim 8 or claim 9, wherein X is Se.

30 11. A compound according to claim 8 or claim 9, wherein X is SO<sub>2</sub>.

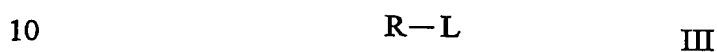
12. A method for preparing a compound of formula I as defined in claim 11, said method comprising reacting a compound of formula II:



wherein:

- 5 M denotes a metal, for example Li, Na, K, Ca, Cs, Zn, Mg, or Al; and  
k denotes 1, 2 or 3;

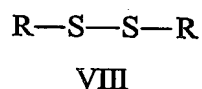
with a compound of formula III:



wherein:

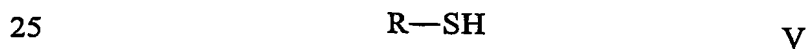
L denotes a leaving group.

- 15 13. A method for preparing a compound of formula I as defined in claim 11, said method comprising reacting a disulfide compound of formula VIII:

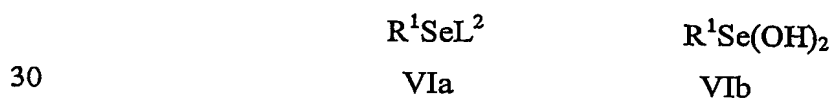


- 20 with a sulfinite anion of formula  $\text{R}^1\text{SO}_2^-$  in the presence of silver ions.

14. A method for preparing a compound of formula I as defined in claim 10, said method comprising reacting a compound of formula V:



with a compound of formula VIa or VIb:



wherein  $\text{L}^2$  denotes Br, Cl, CN, or I.

15. Use of a compound of formula I as defined in any of claims 1 to 7, in disulphide bond formation.
- 5 16. Use of a compound of formula I as defined in any of claims 1 to 7, for modifying a protein, a peptide or an amino acid comprising at least one thiol group.
17. Use of a compound of formula I as defined in any of claims 8 to 11, for glycosylating a protein, a peptide or an amino acid comprising at least one thiol group.
- 10 18. A method of chemically modifying a protein, peptide or amino acid comprising at least one thiol group, the method comprising converting said thiol group into a selenenylsulfide group.
- 15 19. A method according to claim 18, wherein the conversion is carried out by reacting the protein, peptide or amino acid comprising at least one thiol group with a compound of formula Xa or Xb:
- $$\begin{array}{c} \text{R}^2\text{SeL}^2 \\ \text{Xa} \end{array}$$

$$\begin{array}{c} \text{R}^2\text{Se(OH)}_2 \\ \text{Xb} \end{array}$$
- wherein:
- $\text{L}^2$  denotes a leaving group; and
- 25  $\text{R}^2$  denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted benzyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group, or  $\text{R}^2$  forms part of or is attached to a solid support.
- 30 20. A method according to claim 19, wherein  $\text{R}^2$  is phenyl.
21. A method according to claim 19, wherein the compound of formula Xa or Xb is  $\text{PhSeBr}$ .

22. A method according to any one of claims 18 to 21, further comprising reacting the selenenylsulfide group in the protein, peptide or amino acid with an organic compound containing a thiol group.
- 5 23. A method of chemically modifying a protein, peptide or amino acid comprising at least one selenenylsulfide group, the method comprising reacting the protein, peptide or amino acid with an organic compound comprising a thiol group.
24. A method according to claim 22 or claim 23, wherein the organic compound  
10 is a carbohydrate compound.
25. A method according to claim 22 or claim 23, wherein the organic compound is a protein, peptide or amino acid.
- 15 26. A protein, peptide or amino acid comprising at least one selenenylsulfide group, wherein the selenenylsulfide group is a group of formula:
- $$-S-Se-R^2,$$
- 20 wherein  $R^2$  denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted benzyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group.
- 25 28. A protein, peptide or amino acid comprising at least one selenenylsulfide group which is obtainable by the method of any one of claims 18 to 21.
29. A protein, peptide or amino acid comprising at least one disulfide bond which is obtainable by the method of any one of claims 22 to 25.
- 30